Attorney's Docket No. 43774/209425 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Deng
Filed: Concurrently Herewith
For: SMOOTH CAPACITY EXPANSION METHOD AND SYSTEM FOR DATA COMMUNICATION PRODUCTS

April 5, 2001

Assistant Commissioner for Patents
Washington, DC 20231

PRELIMINARY AMENDMENT

Sir:

Please amend the above-referenced application as follows:

In the Specification:

In accordance with 37 CFR 1.125(b), please replaces pages 1-9 of the current application with pages 1-9 of the attached substitute specification.

In the Claims:

Cancel Claims 1-19 and substitute with the following claims:

20. A method for expanding the capacity of a data communication system, in which the system architecture of the data communication system includes at least one circuit card in communication with at least one switched network card, wherein said method comprises the steps of:

providing a first framework that includes at least one circuit card and at least one interface transfer card in communication with one another;

providing a second framework that includes at least one switched network card and at least one interface card in communication with one another; and

providing a data communication link connecting the interface transfer card of the first

framework with the interface card of the second framework to thereby establish communication between the circuit card and the switched network card.

21. A method according to Claim 20, wherein said providing a first framework step comprises providing a first framework further including a back plane for interconnecting at least one circuit card and at least one interface transfer card, and wherein said providing a second framework step comprises providing a second framework further including a back plane for interconnecting the at least one switched network card and the at least one interface card.

22. A method according to Claim 20, wherein said providing a first framework step provides a plurality of first frameworks each having at least one circuit card and at least one interface transfer card, and wherein said providing a data communication link step provides data communication links connecting the interface transfer cards of the plurality of first frameworks to the at least one interface card of the second framework to thereby establish communication between the circuit cards of the plurality of first frameworks and the at least one switched network card of the second framework.

23. A method according to Claim 22, wherein said providing a second framework step provides a second framework that includes a plurality of slots for positioning switched network cards and associated interface cards such that additional switched network cards and interface cards can be added to the second framework to connect with the circuit cards and interface transfer cards of the plurality of first frameworks.

24. A method according to Claim 20, wherein said providing a data communication link step provides an optical fiber connecting the interface transfer card of the first framework with the interface card of the second framework.

25. A method according to Claim 21, further comprising the step of providing at least one passive base card having a first connector for connection to the at least one switched network card via the back plane and a plurality of second connectors for connection to a plurality of miniaturized interface cards, such that each of the miniaturized interface cards are connected to

the at least one switched network card via the passive base card and each of the interface cards can be inserted and removed independently of one another.

26. A method according to Claim 21, further comprising the step of providing at least one passive base card having a first connector for connection to the at least one circuit card via the back plane and a plurality of second connectors for connection to a plurality of miniaturized interface transfer cards, such that the miniaturized interface transfer cards are connected to the at least one circuit cards via the passive base card and each of the interface transfer cards can be inserted and removed independently of one another.

27. A method according to Claim 21, further comprising the steps of:

providing at least one passive base card having a first connector for connection to at least one switched network card via the back plane and a plurality of second connectors for connection to a plurality of miniaturized interface cards, such that each of the miniaturized interface cards are connected to the at least one switched network card via the passive base card and each of the interface cards can be inserted and removed independently of one another; and

providing at least one passive base card having a first connector for connection to the at least one circuit card via the back plane and a plurality of second connectors for connection to a plurality of miniaturized interface transfer cards, such that the miniaturized interface transfer cards are connected to the at least one circuit card via the passive base card and each of the interface transfer cards can be inserted and removed independently of one another.

28. A method according to Claim 20, further comprising the step of providing for each of the at least one switched network cards a back up card connected to the switched network card as a replacement therefor in the event the switched network card malfunctions.

29. A method according to Claim 20, further comprising the step of providing for each of the at least one circuit cards a back up card connected to the circuit card as a replacement therefor in the event the circuit card malfunctions.

30. A method according to Claim 20, wherein said providing first and second framework steps respectively provide first and second frameworks having interface transfer cards and interface cards that use the same interface standard, and wherein multiple pairs of said interface transfer cards and said interface cards use the same speed.

31. A smooth capacity expandable system of data communication comprising:

at least one circuit card and at least one interface transfer card in communication with one another;

at least one switched network card and at least one interface card in communication with one another; and

a data communication link connecting said interface transfer card and said interface card to thereby establish communication between said circuit card and said switched network card.

32. A system according to Claim 31, further comprising:

a first framework that includes a plurality of slots for positioning said at least one circuit card and associated at least one interface transfer card, wherein the slots are interconnected to form connections therebetween; and

a second framework that includes a plurality of slots for positioning said at least one switched network card and associated at least one interface card, wherein the slots are interconnected to form connections therebetween.

33. A system according to Claim 31, wherein said first framework further includes a back plane for interconnecting said at least one circuit card and said at least one interface transfer card, and wherein said second framework includes a back plane for interconnecting said at least one switched network card and said at least one interface card.

34. A system according to Claim 32, further comprising:

a plurality of first frameworks each having at least one circuit card and a least one interface transfer card; and

data communication links connecting said interface transfer cards of said plurality of first frameworks to said at least one interface card of said second framework to thereby establish

communication between said circuit cards of said plurality of first frameworks and said at least one switched network card of said second framework.

35. A system according to Claim 34, further comprising:

additional switched network cards and associated interface cards positioned within said second framework to connect with said circuit cards and interface transfer cards of said plurality of first frameworks.

36. A system according to Claim 31, wherein said data communication link is an optical fiber.

37. A system according to Claim 33, further comprising at least one passive base card having a first connector for connection to said at least one switched network card via said back plane and a plurality of second connectors for connection to a plurality of miniaturized interface cards, such that each of said miniaturized interface cards are connected to said switched network card via said passive base card and each of said interface cards can be inserted and removed independently of one another.

38. A system according to Claim 33, further comprising at least one passive base card having a first connector for connection to said at least one circuit card via said back plane and a plurality of second connectors for connection to a plurality of miniaturized interface transfer cards, such that said miniaturized interface transfer cards are connected to said circuit cards via said passive base card and each of said interface transfer cards can be inserted and removed independently of one another.

39. A system according to Claim 33, further comprising:

at least one passive base card having a first connector for connection to said at least one switched network card via said back plane and a plurality of second connectors for connection to a plurality of miniaturized interface cards, such that each of said miniaturized interface cards are connected to said switched network card via said passive base card and each of said interface cards can be inserted and removed independently of one another; and

at least one other passive base card having a first connector for connection to said at least one circuit card via said back plane and a plurality of second connectors for connection to a plurality of miniaturized interface transfer cards, such that said miniaturized interface transfer cards are connected to said circuit cards via said passive base card and each of said interface transfer cards can be inserted and removed independently of one another.

40. A system according to Claim 31, further comprising for each of said at least one switched network card a back up card connected to said switched network card as a replacement therefor in the event said switched network card malfunctions.

41. A system according to Claim 31, further comprising for each of said at least one circuit card a back up card connected to said circuit card as a replacement therefor in the event said circuit card malfunctions.

42. A system according to Claim 31, wherein said interface transfer cards and said interface cards use the same interface standard, and wherein multiple pairs of said interface transfer cards and said interface cards use the same speed.

REMARKS

The above claim amendments are made to present the claims in accordance with United States practice. Please enter this amendment prior to calculation of the filing fee.

In addition, in accordance with 37 CFR 1.125(b), Applicant presents herewith a substitute specification. Enclosed is a copy of a marked up version of the original specification as filed, indicating by bracketing and underlining the material being added and the material being deleted from the specification. Also enclosed herewith is a clean form of the substitute specification without markings as to amended material. It is submitted that the substitute specification does not include new matter.

Applicant respectfully submits that the foregoing amendment places the application in condition for substantive examination, which action is respectfully requested.

Respectfully submitted,

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Smooth Capacity Expansion Method and System for Data Communication Products

Field of the Invention

The present invention relates generally to a data communication system, and more particularly to a method for implementing smooth capacity expansion of data communication products and a data communication system, which is available for smooth capacity expansion.

Background of the Invention

At present, [client and market] users increasingly require[s] more and more capacity of [the] data communication products, such as ATM exchanges, routers, etc. The [A]architecture of [the present] current ATM exchanges, routers, etc. mainly includes circuit cards, switched network cards, and a back plane connecting the circuit cards and switched network. Generally, such data communication products have [it is] a single framework structure. Accompanying [with] the increased demand for [of] capacity, the design of the products faces [with] the following technical problems:

a) When capacity is more than hundreds of Gbit, there are many circuit cards, such as POS interface circuit cards, ATM interface circuit cards and Giga-bit interface cards etc. Power consumption of the whole machine is larger, and it is difficult to implement them with only one framework. Especially when the capacity of the product is over 160 Gbit, with present technology, the technical problems of structure cannot be solved with a single framework, and [it must use] multiple frameworks may be required. With multiple frameworks, there are problems, such as interconnection between frameworks, main card and backup card switching etc., without successful design scheme.

b) Different markets of data communication [has] have different requirements of rated capacity. Therefore, the manufacturer is asked to provide a series of products, such as 10Gbit, 40Gbit, 80Gbit, 160Gbit, 320Gbit, 640Gbit, 1.2Tbit and several tens Tbit. At present, different series products provided by different manufacturers have different

architectures. Although [part of the] some manufacturers implement circuit card compatibility for one or two series in a single framework, [but] the architecture needs to be changed. There is no successful solution with smooth capacity expansion for all series or from 40Gbit to Tbit series.

c) As data communication develops rapidly, [requirement of] capacity requirements will increase [be larger and larger]. When a client purchases [product of] a data communication product, it is according to the capacity requirement at that time. [Period of time l]Later, usually the capacity needs to be expanded. At present, when capacity expansion is needed, most [of the] manufacturers ask[s] a client to purchase the new generation product [which makes] so that most [of the] old products [could] cannot be used again. In this case, the client needs to [pay more] invest[ment] more for capacity expansion. Therefore, when capacity expansion is needed, it is valuable to protect as much as possible the original investment of a client. For [product of] data communication products investment of circuit cards occupies more [then] than 60% of the hardware cost. Obviously, when a system is upgraded, circuit card compatibility will directly influence the client investment and expansion cost. According to the present technology, when capacity expansion is needed, it is often solved by replacing the product. [, it means when capacity is difficult to satisfy requirement,] Thus expansion problems [is] are often solved by replacing a [less] lower capacity product with a larger capacity product. [It directly conducts whole] Yet an upgrade of client equipment [and upgrade cost] is expensive.

Summary of the Invention

The present invention provides a method to implement smoothly capacity expansion for [products of] data communication products, and a smooth capacity expandable system for data communication. [It] The invention allows a user to implement[s] smooth capacity expansion from Gbit to Tbit. When capacity is [expended] expanded, the original equipment can also be used and the client investment is protected.

[According to t]The present invention[,] provides a method of implementing smooth capacity expansion for data communication products, in which the architecture of the data communication product[s at least] includes at least a circuit card, a switched

network card and a back plane. [, the method comprises:] The method of the invention includes the following steps.

[Set up a] A special framework is set up for a switched network card. [S]A switched network card, which is set in the framework, [creates interconnection] interconnects with an interface card of a switched network through the interface with a circuit card on it and a back plane.

[Set up m]Multiple frameworks are set up for a circuit card. A [C]circuit card, which is set in the framework, [creates interconnection] interconnects with an interface transfer card through the interface switched network on it and a back plane, and each circuit card corresponds to one interface transfer card.

[I]The interface card and interface card of the switched network correspond with each other one [by] to one, and [are] can be interconnected [with] by optical fiber.

When increasing capacity, one can increase smoothly switched network cards and numbers of circuit card frameworks to implement smooth capacity expansion.

The above mentioned interface card of the switched network [will] can be designed as a miniature structure. Multiple miniature interface cards of the switched network are inserted on a passive base card. Each of the miniature interface cards of the switched network can be inserted or removed independently. It connects with the switched network card through the passive base card and back plane.

The above mentioned interface transfer card can also [will] be designed as a miniature structure. Multiple miniature cards of the interface transfer are inserted on a passive base card. Each of the miniature cards of the interface transfer can be inserted or removed independently. It connects with the circuit card through the passive base card and back plane.

The above mentioned switched network card can be equipped [equips] with a backup card. [When] If the main card stops working, the backup card [will] can replace the main card to assure the system works continuously.

The above mentioned circuit card can also be equipped [equips] with a backup card. When the main card stops working, the backup card [will] can replace the main card to assure the system works continuously.

[According to t]The present invention[,] also provides a smooth capacity expandable system for data communication, its architecture [at least comprises] comprising at least a circuit card and a switched network card. [, it is characterized with:] The system includes the following.

The [said] data communication system [further comprises] includes an interface card [of] for the switched network and an interface transfer card. The [said] circuit card connects with the switched network card through the interface transfer card and interface card of the switched network.

[According to] The architecture of the [said] data communication system of the invention [its architecture] further comprises a back plane. [S]The switched network card connects with the interface card of the switched network through the interface of the circuit card on it and the back plane. [C]The circuit card connects with the interface transfer card through interface of the switched network on it and the back plane.

[According to t]The [said] data communication system of the invention[, it is] further includes [set up] a special framework for the switched network card. [Inside the framework, it is at least set up the said] The switched network card and interface card of the switched network are included in the framework; the switched network card interconnects with the interface card of the switched network through the interface of the circuit card on it and the back plane. [It is further set up] The system can further include multiple frameworks for the circuit cards. [Inside the frameworks, it is set up the said] The circuit card and interface transfer card are within the frameworks; the circuit card interconnects with the interface transfer card through the interface of the switched network on it and the back plane. [And e]Each circuit card corresponds with an interface transfer card. [I]An interface transfer card corresponds with an interface card of a switched network one [by] to one, and their connections [are] can be set by optical fiber.

When capacity of the system is expanded, [it keeps] the original switched network cards, circuit cards and back planes are unchanged. Smooth capacity expansion is implemented by increasing smoothly switched network cards and numbers of circuit card frameworks.

[According to the said] The data communication system of the invention[, it also] can further comprise[s] a passive base card. The [said] interface card of the switched

network can be a miniature structure. Multiple interface cards of the switched network [are] can be inserted on a passive base card. Each of the miniature cards can be inserted and removed independently. They connect with switched network cards through the passive base card and the back plane.

[According to the said] The data communication system of the invention[, it also] can further comprise[s] another passive base card. The interface transfer card can be a miniature structure. Multiple interface transfer cards are inserted on a passive base card. Each of the miniature cards can be inserted and removed independently. They connect with circuit cards through the passive base card and the back plane.

According to the [said] data communication system of the invention, the [said] switched network cards [are] can be further equipped with backup cards. When the main card stops working, the backup card [will] can replace it to assure the system works continuously.

According to the [said] data communication system of the invention, the [said] circuit cards can also be [are] equipped with back up cards. When the main card stops working, the backup card will replace it to assure the system works continuously.

The [said] interface [of] for the circuit card, which is on the switched network card, and the [said] interface [of] for the switched network, which is on the circuit card, [is] all preferably use [using] the same interface standard. Multiple pairs of the interfaces also preferably use[s] the same speed.

The invention solves the interconnection between frameworks by using the interface transfer card, interface card of switched network and optical fiber. It has broken the limitation of [a] framework space and volume, and makes capacity expansion [is] possible. When the capacity is expanded, [it keeps] all original circuit cards and switched network cards are unchanged; in this way, client investment is protected and the cost of upgrade and capacity expansion is decreased greatly.

The Drawings

Figure 1 [schematic] schematically illustrates the structure of a circuit card.

Figure 2 [schematic] schematically illustrates the structure of a switched network card.

Figure 3 [schematic] schematically illustrates the interconnection between a switched network card and a circuit card in a single framework structure.

Figure 4 is an outside view of an exemplary mechanical structure for a single framework.

Figure 5 [schematic] schematically illustrates the interconnection of the invention.

Figure 6 is an outside view of an exemplary mechanical structure of the invention.

Figure 7 is a schematic diagram of a base card.

Detailed Description of the Invention

In the following combining with the Figures, the invention is described in detail from circuit card structure, single framework structure to multiple frameworks structure in sequence. Among them, multiple frameworks structure and the expansion mode from single framework to multiple frameworks are more important to the invention.

[Reference to] Figures 1 and 2[, they are the] illustrate schematic structures of a circuit card 10 and a switched network card 20, respectively. The circuit card 10 includes interfaces and processing control logic of various kinds. Except when the interface 2 connecting with a switched network needs to be restricted, [client] a user according to a particular product requirement can define the interface 1 connecting with outsides and the others. The switched network card 20 has exchange function and logic processing function of various kinds, and includes the interface 3, which connects with circuit card 10. The interface 3 interconnects with the circuit card's switched network interface 2, and they have the same standard.

[Reference to] Figure 3[, there is] illustrates the interconnection between switched network card 20 and circuit card 10. There are two switched network cards 20, one of which is the main and the other is the backup[, which]. The two switched network cards 20 are connected with circuit card 10 by standard interface 2 and 3. The purpose[s] of two switched network cards 20 [are for] is reliability.

The interconnection between switched network card 20 and circuit card 10 is an internal standard interface, [it is] such as an electric signal interface. In order to [the expansion is] smoothly expand capacity, the interface must be standardized. When capacity is less, for example less than 160G, the product can be designed within a single

framework, [therefore] and the interface is connected through back plane 4. The physical requirements of the interface signals are: signal transmission mode is high speed, serial and differential mode; and transmission rate is over 1G. In order to better select[ing] an interface device, it is suggested using [the] a standard interface device, such as interface standard of Fiber channel, Gigabit Ethernet, OIF and Infiniband and so on. General transmission rate is 1Gb/s, 1.25Gb/s, 1.5Gb/s, 2.5Gb/s and 3.125Gb/s and supports 8B/10B signals coding. For a product only one of the transmission rate can be selected, otherwise it is difficult to have a smooth expansion. Therefore, multiple internal interfaces use the same transmission rate. When the capacity is larger, it is suggested using the 2.5Gb/s.

Figure 3 is the scheme of basic capacity. The switched network cards 20 and the circuit cards 10 are interconnected by [B]back plane 4. The main card and backup card of switched network cards 20 [occupies] occupy one slot, respectively. Each circuit card 10 occupies one slot. The schematic mechanical structure is shown in Figure 4. The numbers of circuit cards 10 can be changed according to the port numbers of switched network card 20. In Figure 4, there are 16 circuit cards 10, two switched network cards (NET) 20 and two cards of main processing unit (MPU). Switched network card 20 and other cards are interconnected by the back plane 4. The main functions of the MPU card are system management and maintenance. Two MPU cards are used for main and backup, respectively.

When system capacity is to be increased, connection between frameworks is needed. In this case for the system reliability, the expansion and reliability must be better solved. The smooth expansion scheme according to the invention is:

- Without changing the original circuit card 10, switched network card 20 and back plane 4.
- Increasing the numbers of switched network cards 20 and putting them in a special framework for switched network card.
- Increasing the numbers of circuit cards 10, which compose framework for circuit card. The multiple frameworks of circuit cards are interconnected with the special framework of switched network card by parallel optical fiber. At

the same time, the slot originally for switched network card 20 is used for an interface card which interconnects with the special framework of the switched network card.

[Reference] Referring to Figure 5, the dotted line 4 is the back plane, and [the] 50 is optical fiber. In this scheme, two kinds of cards are added: [the] one is [30 referred to as] an interface transfer card 30 and the other is [40 referred to as] an interface card 40 of a switched network. The interface transfer cards 30 are inserted in the slots, in which [are inserted] originally the switched network cards 20 were inserted[,] when there [is] was only one framework. Each circuit card 10 corresponds to [with] one interface transfer card 30. The interface card 40 of the switched network [40] and the increasing switched network cards 20 are put in a special framework of switched network cards. Each circuit card 10 corresponds with one interface card 40 of a switched network [40], that is the interface cards 40 of a switched network [40] and interface transfer cards 30 correspond one [by] to one. The schematic outside view of a mechanical structure of the scheme is shown in Figure 6.

Figure 6 illustrates two [Two] kinds of frameworks: one is the circuit card framework 80 including circuit cards 10 and interface transfer cards 30, and another is a special framework 70 including switched network cards 20 and interface cards 40 of the switched network [40, are involved in the invention, which]. This provides the smooth capacity expansion scheme. When increased[ing] capacity is desired, if the capacity of switched network card 20 is enough to support the desired increase, [increasing, the purpose of] smooth capacity expansion can be [got] achieved by increasing the numbers of interconnecting circuit card frameworks 80. Figure 6 shows only four circuit frameworks and four switched network cards. In a real situation, the numbers of circuit card frameworks 80 can be more and the numbers of switched network cards 20 can be more too. Smoothly increasing [of] capacity is implemented by smoothly increasing the circuit card frameworks 80 and switched network cards 20.

Therefore, the invention breaks the limitation of a single framework and makes the implementation of smooth expansion to be real.

In the invention, in order to use sufficiently and without influence of back plane 4 in circuit card framework, the design of interface transfer card 30 must be more compact. As the function is simple and the devices are less for interface transfer card 30, its structure can be in miniature. Many interface transfer cards 30 in miniature can be inserted in a base card, so that each one of them can be inserted and removed independently. When replacing an interface transfer card 30, it is assured that another circuit card 10 will not be influenced, and this is an on-line exchange. The base care is a passive card. Figure 7 illustrates [is] the schematic connection of the base card. Multiple pieces of interface transfer card 30 in miniature are all inserted on the passive base card 60. Passive base card 60 is inserted on the back plane by interface 61, which creates the corresponding connecting relationship between circuit card 10 and interface card 30. Interface 62 is an optical fiber interface.

Similarly, the interface card 40 of a switched network [40] inserted on the special framework of switched network card can employ the same structure to make the structure more compact[ness].

In addition, circuit card 10 and switched network card 20 can all have backup cards. When the main card is removed, or is at fault, or stops working, the backup card will replace the work of main card, to keep the system operat[es]ing continuously and provide[s] uninterrupted service [without interrupted]. Therefore, when the expansion is from a signal framework to multiple frameworks, [it can be first removed] the backup card can be first removed, then exchanged the interface transfer card 30, interface card of switched network 40 etc. After the exchanging, it is switched to operate on the backup switched network card, then exchanging the main switched network card without interrupting the service.

Simulation test shows that the invention implements smooth expansion, without interrupting the service and with reliable performance.

The [said] above is only [an] one embodiment of the invention, and does [it is] not limit[ed] the scope of the invention. The invention implements the framework interconnection by adding the interface transfer card, interface card of a switched network and optical fiber between the circuit card and the switched network card. When expanding capacity [expansion], the original circuit card and switched network card need

not be [make any] change[s,]d. [it] One only need to increase smoothly the numbers of switched network cards and frameworks of circuit cards. [In t]This [way, it] implements the smooth expansion and protects the client investment. Under the spirit and principle of the invention, any update, replacement or improvement, etc. are all [involved in] included within the scope of the claims of the invention.